

DOCUMENT RESUME

ED 253 720

CE 040 712

TITLE A Planning Guide for Montana Industrial Education/Technology Programs.

INSTITUTION Montana State Univ., Bozeman. Dept. of Agricultural and Industrial Education.

SPONS AGENCY Montana State Dept. of Public Instruction, Helena.

PUB DATE Jan 85

NOTE 29p.

PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC02 Plus Postage.

DESCRIPTORS *Classroom Techniques; Course Content; *Curriculum Development; Educational Philosophy; *Educational Planning; Educational Practices; *Educational Resources; Educational Trends; Futures (of Society); Industrial Arts; Postsecondary Education; Program Development; Secondary Education; State Curriculum Guides; Statewide Planning; Teaching Methods; *Technological Advancement; *Trade and Industrial Education

IDENTIFIERS *Montana

ABSTRACT

This technology implementation plan for industrial education has been developed to provide Montana educators with an articulated plan for industrial education from junior high through adult levels. It is intended to help the teacher to (1) develop an understanding of the philosophical base upon which a forward-looking industrial education program is founded, (2) identify a curriculum development procedure and teaching strategies, and (3) locate resources and educational aids to supplement curriculum materials. The guide covers the five levels of the Montana Plan for Industrial Education, which is designed to reach students from grades 7 to adult, and then takes the teacher step-by-step through a process for implementing technology into their programs. It includes information on why the program is justified, where it is going, who the teacher has to work with, what needs to be done on each level, how to implement it, and when to begin. An annotated section of resources includes lists of books, organizations, and periodicals. (KC)

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A Planning Guide for Montana Industrial Education/Technology Programs

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Dept. of Agricultural and Industrial Education
Montana State University
Bozeman, Montana 59717
January, 1985

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Introduction

This technology implementation plan for Industrial Education has been developed to provide educators with an articulated plan for: industrial education from junior high through adult levels. Curriculum guides and materials will be prepared at a later date which specifically relate to each level.

This Planning Guide serves as a useful tool for all industrial educators and administrators as they plan curricula to meet the needs of their students within their facilities and resource constraints. It will help the teacher to:

- develop an understanding of the philosophical base upon which a forward looking Industrial Education program is founded.
- identify a curriculum development procedure and teaching strategies, and
- locate resources and educational aids to supplement curriculum materials.

While utilizing this Planning Guide, the teacher should keep in mind that it attempts



to cover a broad range of situations and environments. It can provide a valuable foundation of ideas, suggestions, alternatives, and recommendations. Thus, teachers are encouraged to use the ideas presented to improve their industrial education programs by developing the best curriculum possible to meet the needs of today's students in a technological society.

Rationale

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Discoveries are being made worldwide every day. Innovations in communication, medicine, transportation, robotics, energy, and aerospace technology are only a few of the fields under constant exploration and transition. This is accomplished by a society that yearns to discover and strives to excel. These qualities are evidenced by the fast pace at which new innovations reach the marketplace or become the subject of feature stories in the mass media.

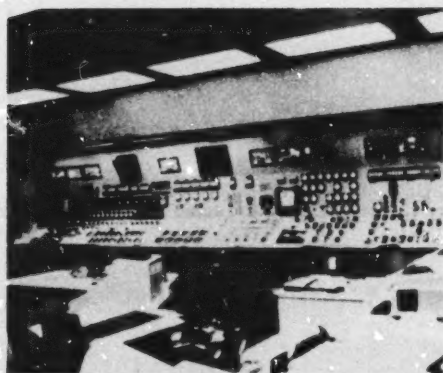
Most people will agree that the standard of living has increased dramatically. People do things differently today than they did 100, 50, 25—or even 5 years ago. Technology is one of the causes for these changes. For example, the way we communicate is changing. Note the cable TV network, cordless phones, and electronic mail service. Energy utilization systems encompass more

than the traditional fossil fuels. Production systems have clearly gone beyond the human operated mass production line as computer aided manufacturing (CAM) and robotics displace many factory workers. The space shuttle, too, has become a major breakthrough in transportation technology.

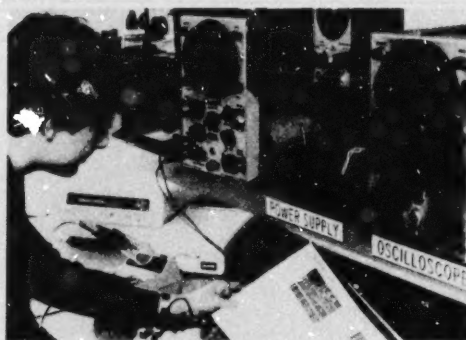
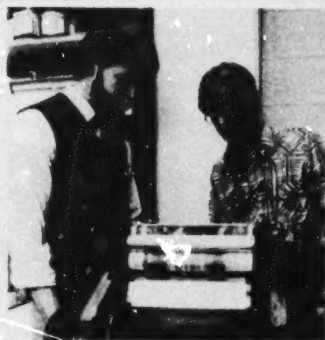
As we look at how technology has caused changes and think about the possibilities in store for the future, it becomes necessary to ask ourselves an important question. As educators, administrators, or parents, do we believe that the present industrial education programs are meeting students' needs by preparing individuals who can cope with, live in and work in an industrial/technological society?

As we evaluate our industrial education program, it would be likely that some teachers are addressing a few of the new technologies. It is doubtful, however, that a majority of the industrial education programs have updated their curriculum significantly.

In keeping with the characteristics of the American society, it has become necessary for the educational system to discover and excel. Just as doctors are expected to keep current with new developments in medicine, lawyers to stay abreast of new laws, accountants to decipher new loopholes in tax forms and auto mechanics to be able to repair anything from a '67 Chevy to a late model Ford—there are expectations of



educators. Today's teachers need to be teaching students about today and preparing them for tomorrow. Other areas of the curriculum have worked to update their programs and the time has come for industrial education to follow suit. We need to be looking at today's technologies and today's industries. Montana's plan for Industrial Education strives to provide direction to educators as they plan, manage, and evaluate their curricula to help students become technologically literate and equipped with the necessary skills to cope with, live in and work in an industrial/technological society.



An updated industrial education program can help a student to grow physically, mentally, and socially; physically as a being able to manipulate tools and materials to solve current problems, mentally as an individual who can understand technological change and how to deal with it, and socially as a person who is capable of relating to individuals and interacting with people as he/she cooperates with others to find solutions and make decisions.

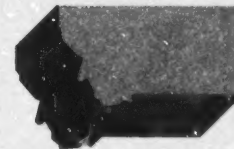
This planning guide is a new tool for educators. It is a guide that teachers and administrators can employ as a reference while they take a look at their industrial education program to determine utility and effectiveness. Just as other more familiar tools are used to shape, form, finish, and manipulate products, this planning guide is an instrument to help industrial educators to plan, manage, and evaluate programs.

In order for us to accomplish this major effort in updating our industrial education programs, five goals have been developed which summarize the focus of this plan.

The learner goals for the industrial arts program would include:

1. The establishment of beliefs and values based upon the impact of technology and how it alters environments.
2. The development of attitudes and abilities in the proper use of tools, techniques, and resources of technical and technological systems.
3. The development of creative solutions to present and future societal problems using technical means.
4. The understanding and appreciation of the evolution and relationships of society and technical means.
5. The exploration and development of human potentials related to responsible work, leisure, and citizenship roles in a technological society.

Each of the five goal statements above can be met in the courses taught at each level. Instruction may be made appropriate to the student's learning ability at each level.



The Montana Plan for Industrial Education

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The Montana Plan for Industrial Education

Grade		Areas of Study	Program Emphasis
Adult	Level 5		
14		Advanced Technical and Vocational Education Studies	<i>Preparing for life in a technological society</i>
13	Level 4		
12		Self Directed Enterprise	<i>Becoming oriented to a technological society</i>
11	Level 3	Model Enterprise	
10			
9	Level 2	Production Transportation Communication	<i>Becoming aware of and exploring technology in our everyday life</i>
8			
7	Level 1	Introduction to Technology	
6			
5			
4			
3			
2			
1			
K			

Figure 1

In the junior high/middle school level (grades 6, 7, and 8) the student will have the opportunity to explore industry and its technologies. Units of study will be developed which introduce the student to the broad spectrum of industrial and technological resources, processes, applications, and their impacts on society and the environment (see Fig. 1).

At the secondary level (grades 9-12) it is suggested that one semester courses be developed that will orient the student to the three major technological areas. These are Production (Manufacturing and Construction), Communication, and Transportation.

Third level courses will be developed to provide the students an opportunity to participate in technology through model and self-directed enterprise.

The upper senior high through adult level (grades 11-adult) is subdivided into two areas: advanced technical studies and vocational programs. Students choosing the advanced technical studies program are involved in individualized, research and development, independent-group study, laboratory-based courses. Students choosing vocational programs are involved in courses that provide employment skills in a variety of specific industrial occupations.

As one progresses through the awareness and exploratory level, then the orientation

The Montana Plan

level, each of the program goals is being met to greater depth. Due to the flexibility of this plan, it can be implemented into existing programs and facilities. Thus, it can render assistance to educators as they plan curricula to meet the changing demands and needs of an information society.

As teachers become familiar with this curriculum plan, it may seem overwhelming. The initial reaction of most teachers is excitement and anxiety. This planning guide was developed in an attempt to alleviate anxiety and provide teachers with feasible alternatives. Educators are strongly urged to take advantage of the suggestions presented in this planning guide. Many of the comments and suggestions were made by Montana industrial educators at workshops offered in the spring of 1984. Look at the model which follows (Fig. 2) as you begin the step-by-step approach to implementing the Montana plan for industrial education.

Planning Guide Model

Why	Why are you doing this?	11-Adult Advanced Technical and Vocational Education Studies
Where	Where do you want the curriculum to go?	
Who	Who are you aiming the curriculum effort towards?	10-12 Model Enterprise and Self-Directed Studies
What	What needs to be done?	
How	How do you go about it?	9-10 Production Transportation Communication
When	When should you start?	
Now	Continuously re-evaluate your curriculum by asking what, how, and when.	K-8 Exploring Industries and it's Technologies

Figure 2

Steps To Implementing Technology Into Your Program

Why

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1. Think about why you teach your (industrial arts) classes the way you do. Is it because...
 - That's how you were taught?
 - It's always been that way at your school?
 - You don't know of another way?
 - You believe it meets the needs of today's society?
2. Now, see if you can justify the learning activities and teaching strategies that take place in your laboratory. In other words, develop a rationale for your program. A rationale simply explains *why* you do the things you do.
3. Did that seem rather difficult? For most teachers it is. The reason is that many people never stop to think about why they do things. They don't take a break

from their daily routine to question themselves. Some example questions include:

- Why do I want my students to know the parts of a wood plane?
 - Do my students really need to become proficient with all the tools and machines in the laboratory?
 - Why do my introductory students have a difficult time drawing orthographic sketches of those imaginary box shapes?
 - Is there a better way of encouraging students to learn about modern industry and technology?
4. The answer to these questions as well as similar ones is probably, "I don't know." Teachers need to understand why they teach the courses that they do. It is so much simpler to teach when you really believe that the content is valid and important. So, an initial step in the planning process is to develop a good rationale. If you have not already done so, take this opportunity to read the Rationale for Montana's Plan for Industrial Education on page 1.

Program Justification

How it is often done

Start running a program

Rationalize what you are doing

How it should be done

Establish a rationale

Design a program that is consistent with it

In developing a rationale, be sure to relate your program goals and learning experiences directly and indirectly to the goals established by your board of education. Developing a sound rationale is critical to having a successful teaching experience and program.

Where

5. Throughout the planning process you need to always keep the major program emphasis in mind. Think of it as a target where all the learning activities and teaching strategies bring students closer and closer to the ultimate aim.

Major Program Emphasis

To help students become technologically literate and equipped with the necessary skills to cope with, live in, and work in a highly technological society.

6. You now have a well-defined target. When you know where you're going, it's a lot easier to get there. Take another look at the 5 goals of Montana's plan for industrial education.

1. The establishment of beliefs and values based upon the impact of technology and how it alters environments.
2. The development of attitudes and abilities in the proper use of tools, techniques, and resources of technical and technological systems.
3. The development of creative solutions to present and future societal problems using technical means.
4. The understanding and appreciation of the evolution and relationships of society and technical means.
5. The exploration and development of human potentials related to responsible work, leisure, and citizenship roles in a technological society.

Who

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7. Do you see how each of the goals parallel the levels presented in the model? Look at it this way (Fig. 3):

Level/Goal Parallels

		Goals	
Level 4	11-Adult	To use technical information and skills to solve problems related to and advanced technological society	To prepare students with the necessary knowledge and skills to become gainfully employed or advanced in industrial related occupation
Level 3	10-12	To encourage students to expand their knowledge of technology through self directed and model enterprise	
Level 2	9-10	To orient students to the technologies of communication, production, and transportation	
Level 1	K-8	To foster an awareness of technology and its impact on society and provide exploratory experiences in a wide range of technological situations	

Figure 3

8. Notice how each level of the model is separated by dotted lines. This indicates that there is not a clear break-

ing point between levels. For example, ninth and tenth grade students would probably focus on the orientation objective but would also be involved in some learning situations that would require awareness, exploration, and even preparation. Junior high students will devote most of their attention to awareness-type objectives but could certainly be required to do some exploration, orientation, and preparation-like activities. The key is that at different levels throughout the sequence a certain area becomes the primary focus while the others become secondary. The level you select will depend on the age and maturity of your students. Decide now where the focus of your program is.

9. You've already accomplished three important tasks...
- You know where you're going
 - You know why you want to get there, and
 - You know who you have to work with.
- Believe it or not, you're halfway there!

10. It's quite likely that you may be wanting to deal with a few levels at the same time. In that case you will simply want to be sure to review the planning information that applies to these levels. As we enter the next phase of the planning process, this becomes especially crucial.

What

11. What needs to be done?

This is a key question in the planning process. If you can identify everything that will need to be done now, then the process of determining feasible paths to reach these objectives will be much simpler.

12. At this point you will need to identify the contents of the new curriculum—you want to determine “what” to teach. The steps in the process will branch here to provide you with specific directions for the level you have chosen. Just follow the level that you intend to develop.

Educational Program Classifications

Curriculum development requires knowledge of the definitive characteristics of learners at each of the educational program classifications: Early Childhood Education, Middle Childhood Education, Adolescent Education, and Adult Education. The learner characteristics are presented as a basis for consideration by educators who are determining industrial arts curriculum and instructional development. The information provides direction to program developers as they design, develop, implement, monitor, evaluate, and reconceptualize



industrial arts programs that successfully meet the perceived and individual needs of learners.

Early Childhood

(3 years to 10 years)

Learners are interested in working individually and in small groups during early childhood. They need active participation in structured settings with flexible standards. Concrete experiences, short tasks, and simple procedures should be provided. The development of acceptable habits of performance should be rewarded by ample praise and encouragement. Eye-hand coordination and strength limitations restrict the range of tasks that may be accomplished. Learners need planned sequential experiences that increase in breadth, depth, and complexity.

Middle Childhood

(10 years to 14 years)

Middle childhood is a time of increasing need for acceptance by peers while both adult approval and individuality are still important. Team activities that provide for the wide range of individual development may be competitive or seek to earn money for the group. Despite their restlessness and pervasive need for activity, learners at this stage are concerned about safety and values clarification. They need accepting leaders and an understanding teaching approach as they attempt to learn. Learners in the middle childhood years should have the opportunity to explore specific interest areas and expand their individual potentialities.

Adolescence

(14 years to 19 years)

As adolescents assert their independence of adults, they still seek positive guidance to help them make decisions and develop

values. They have a tendency to be more interested in their physical appearance and peer acceptance than most other parts of their lives. As they seek to develop uniqueness, they may tend to go to emotional extremes. Adolescents need experience in making decisions in the security of the school setting. They are interested in value questions and economic motivations. Learning experiences that tend to become more specialized should be provided for adolescent learners.

Adulthood

(19 years-)

Adults are still evolving their value systems, exploring learning styles, and developing competencies. The diversity of interests and abilities is at a maximum during adulthood. The range of activities and pursuits covers the full spectrum of cognitive, affective, and psychomotor domains.

Educational program developers must be continually cognizant of the relationship of learning theories, learning hierarchies, new areas of study in brain periodization and right and left brain learning. There are numerous preoperational, concrete, formal, and abstract industrial arts education activities that are of benefit to learners in the enhancement of their understanding of an industrial and technological society. Learners can benefit immeasurably by participating in an industrial arts program that provides them the opportunities for recognizing the problem aspects of an industrial and technological society, identifying the major pressing problems of an industrial and technological society, and participating in problem solving activities in industrial arts classroom instruction.



Level 1 Junior High School/ Middle School 6, 7 & 8 Grades

- A. At the junior high level, the teacher is presented with many options for curriculum content. The primary objective is to help students to become aware of and explore industry and its technologies. Communication, production, transportation, and the impact of these technologies has been identified as the content for this level. To provide junior high students with a broad exploration it would seem, then, that a curriculum that included something from each of the systems would be a good foundation for



A Model for Junior High/ Middle School Curriculum

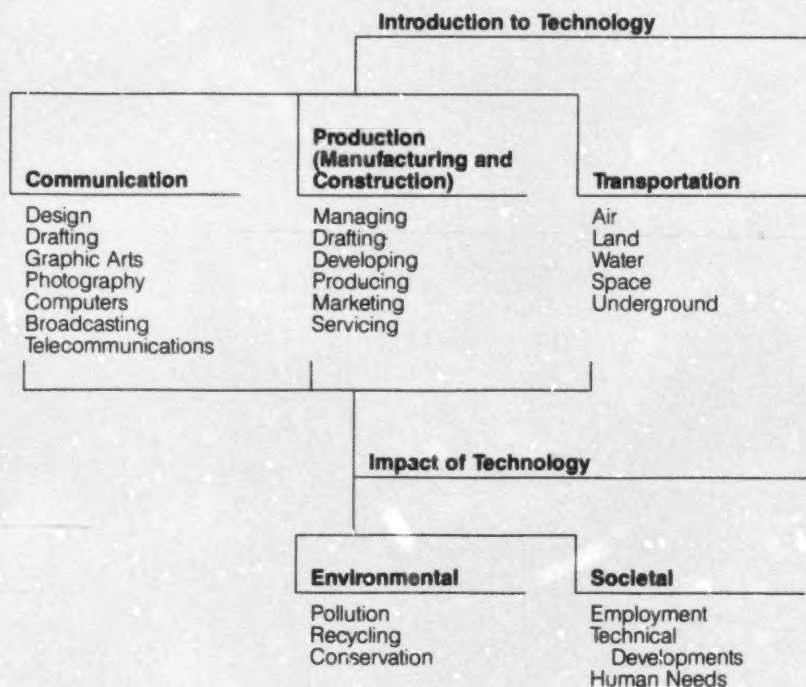
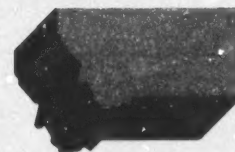


Figure 4

students to build on as they explore industry and its technologies.

- B. Take a look at the junior high curriculum model at left (Fig. 4).
- C. The model should help you to visualize what the content of junior high industrial arts courses could encompass. Listed in Figure 5 are possible unit titles that could be presented in the classroom. Read these to get an idea of some opportunities available to you.
- D. If you look back again at the units outlined, you'll notice the five units under the subtitle "impact of industry on Environment." The other units represent the 3 technologies of communication, production, and transportation.
- E. Hopefully, you can now see that there are many choices for curriculum content



Course Content

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Communication

Taking and processing photographs
Printing messages
Using radio and television to communicate
Communicating through drafting
Using the computer in industry

Production

Processing industrial materials
Constructing shelters
Researching and developing products
Manufacturing industrial products
Servicing industrial materials

Transportation

Transportation with land vehicles
Transporting on water
Moving materials in plant—materials handling
Traveling through space
Aviation technology

Impact of Industry on Environment

Recycling industrial materials
Limiting industrial pollution
Conserving energy sources
Identifying industrial careers
Coping with technology and the future

Figure 5

at the junior high level. As you choose content, always keep the major program emphasis and your objectives in mind.

- Choose units representative from each of the systems and the "impact" section.
- Relate the units to one another.
- To provide variety, consider shortening the units to two weeks so you can provide more exploration.
- Select activities that will expose the students to a variety of situations.



- Make changes in the units to fit your facilities and needs.

F. You should have a good idea about what to teach. Once you have chosen the content, you will need to write objectives and develop teaching strategies. For now, look at what else needs to be done as you prepare to update your curriculum. We'll be addressing this question with all the levels together near the end of this guide.

Level 2 9-10 Grade

- A.** Identifying content for courses at the ninth grade level is an easy task when you use the curriculum models that have been developed.
- B.** The curriculum models are an expandable outline of course content. All

Becoming Oriented to a Technological Society Level 2

Communication Production Transportation	Resources	Input
	Technical Processes	Process
	Industrial Application	Output
	Technological Impact	Feedback

Figure 6

models are divided into four areas: Resources, technical processes, industrial application, and technological impact (see Fig. 6).

- C.** The selection of these areas is based on the definition of a "system"—an activity that includes input-process-output as well as the results of this sequence of events. Resources are the "input," technical processes the "process," industrial application the "output," and technological impact the "results." The model, then, provides a content for each of these four areas. Additional content may be added to each course as technology expands.

- D.** The content for the course is selected from the model.

Here's how:

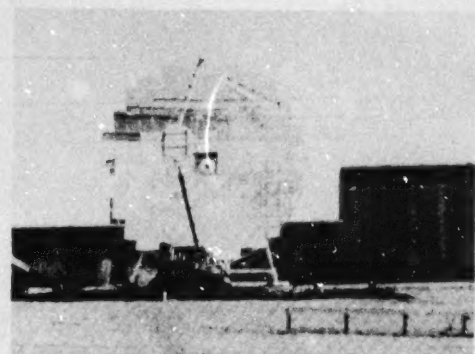
1. Determine the units for the course by selecting titles from one area of the model. The technical processes area or the industrial application area is generally a good area to choose (Figs. 7a, b and c).
2. Then select topics for each unit. Every unit must include content from all four

Production Technology

Resources	Technical Processes	Industrial Application	Technological Impact
Materials Polymers Natural Wood Leather Cotton Synthetic Thermoplastic Thermoset Ceramics Vitrified Nonvitrified Metals Ferrous Nonferrous Capital Working Money Investment Profit Purchases Inventory Loan Fixed Facilities Tools Equipment Human Management Top-level Mid-level Supervisory Supportive Technical Engineers Technicians Architects Production Skilled Unskilled Semi-skilled	Material Processing Measuring Precision Surveying Weighing Tolerancing Forming Casting or Molding Compressing or Stretching Conditioning Separating Turning Drilling Milling and Sawing Shaping and Planing Grinding and Sanding Shearing Combining Mixing Coating Bonding Mechanical Fastening Manufacturing/Construction Establishing the Company Structure the Company Formalize Management Practices Conduct Financial Affairs Designing the Product and Structure Researching Developing Engineering Producing Preparing for Production Preparing to Build Plant Layout Tooling Preparing the Site Process Build Effectively Move Materials Assembly Control Quality Finish Product Structure Marketing Researching Market Selling Distributing Advertising Servicing Altering Repairing Installing Maintaining	Communication Manufacturing Transmitters Receivers Message Carriers Presses Cameras Construction Towers Buildings Billboards Service Repair Alter Install Maintain Transportation Manufacturing Cars Trucks Trains Airplanes Boats Space Vehicles Conveyors Construction Roads Bridges Railways Docks Airports Space Stations Tunnels Service Repair Alter Install Maintain Energy Utilization Manufacturing Photovoltaic cells Pipes Trucks Pumps Cables Generators Windmills Construction Mines Dams Power Plants Off-shore Drilling Platforms Solar Efficient Structures Pipelines Service Repair Alter Install Maintain	Societal Human Needs Food Shelter Employment Retrain Move to Job Living Conditions Appliances Foods Comfortable Shelters Increased Leisure Time Recreational Opportunities State National Concerns Unemployment Worker Displacement Military Superiority National Defense Morals and Values Interdependency of Nations Throw-away Society Technology Assessment Cybernetics Robotics Automation Innovations Past Present Future Environmental Pollution Air Land Water Space Underground Resources Recycling Aluminum Glass Paper Conservation Energy Materials Finite Supplies Petroleum Metals

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Figure 7a



Transportation Technology

Resources	Technical Processes	Industrial Application	Technological Impact
Power Sources Electrical AC Motors DC Motors Natural Animal Wind Gravity Human Heat Engines Steam Rocket Jet Diesel Gas Human Management Top-level Mid-level Supervisory Supportive Technical Engineers Technicians Operators Production Skilled Unskilled Semi-skilled Transportation Media Terrestrial Movement of People Random Route Cycle Automobile Fixed Route Railway Elevator Movement of Goods Vehicular System Railway Truck Stationary System Pipeline Conveyor Robot Atmosphere Lighter-than-air Modes Balloons Airships Heavier-than-air Modes Prop Jet Marine Inland Waterways Boats Barges Transoceanic Maritime Tankers Freighters Submarines Space Unmanned Missiles Satellites Space Probes Manned Spacecraft Space Shuttle	Propulsion Systems Energy Storage Electric Hybrid Hydrogen Flywheel Chemical Conversion of Energy and Power Open Cycle Closed Cycle Internal Combustion External Combustion Intermittent Combustion Continuous Combustion Power Transmission Mechanical Simple Machines Wheels Gears Covers Augers Linkages, Couplings, Shafts Clutches Brakes Fluid Pneumatic Hydraulic Electrical Wires Radiant Fiber Optics Lasers Control Systems Actuating Mechanical Pneumatic Hydraulic Electric Arresting Hydraulic Mechanic Regulating Speed Direction Altitude Guiding Navigating Steering	Communication Information Gathering On-Scene Reporting (Mini-Cam) Researching Information Processing Material Handling Information Distribution Satellite Positioning Newspaper Delivery Relay Stations Express Mail Postal System Energy Utilization Material Extraction Drilling Mining Material Transfer Storage Delivery Production Material Handling In-Plant On-Site Product Distribution Selling Warehousing Installing Servicing	Societal Human Demands Mobility Move Fast Travel Comfort Efficiency Leisure Safety Morals and Values Variety Quality Economy Luxury Appropriate Use Technology Assessment Mass Transit Global Transit Personal Transportation Technical Developments Past Present Future Environmental Pollution Smog Oil Spills Toxic Waste Accidents Resources Recycling Used Cars Tire and Rubber Oil Conservation Fuel Consumption Speed Control Mass Transit Finite Fuel Supply Alternative Power Sources

Figure 7b

areas: resources, technical processes, industrial application, and technological impact. By selecting content from all four areas, the student is assured of gaining a broad perspective and orientation.

E. When your course content is determined, objectives and teaching strategies

must be written and identified. But, besides knowing what to teach, there are a few other points that need to be commented upon to complete our discussion of "what needs to be done." These points will be reviewed with all the levels together near the end of this guide.

Communication Technology

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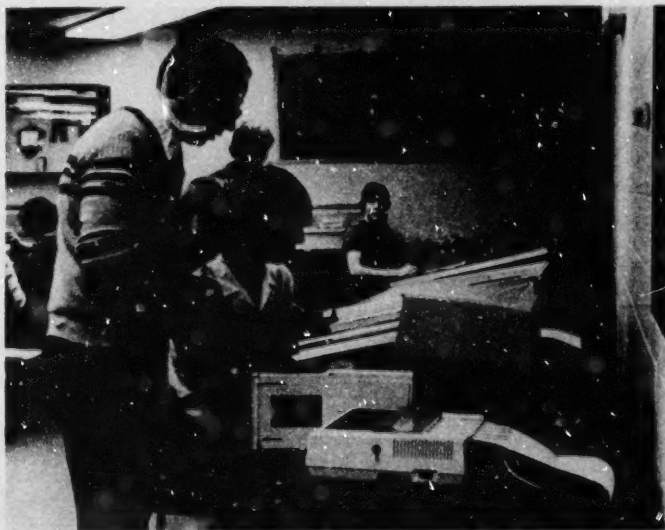
Resources	Technical Processes	Industrial Application	Technological Impact
Equipment Graphic Presses Drafting Machines Copiers Plotters Electronic Computers Transmitters Receivers Typesetters Satellites Optical Lasers Optical Fibers Cameras Materials Magnetic Audio Tapes Video Tapes Diskettes Light Sensitive Films Plates Photographic Paper Chemicals Developers Stop Baths Fixers Papers Rags Bonds Vellums Boards Human Management Top-level Mid-level Supervisory Supportive Technical Engineers Technicians Architects Production Skilled Unskilled Semi-skilled	Graphic Designing Ideas Layout Sketching Drafting Architectural Engineering Mechanical Photography Still Motion Printing Processes Relief Offset Intaglio Electrostatic Screen Technical Writing Reports Instruction Marketing Research Electronic Data Processing Computer Graphics Digital Control Data Storage and Retrieval Application Programming Word Processing Calculating Recording Tapes Records Video Discs Transmitting and Receiving Radio TV Telephone Microwave Data Links Ham Radio Citizen's Band	Production Drafting CAD-CAM Quality Control Marketing Advertising Design Electronic Mail Energy Utilization Consumer Information Systems Control Monitoring Schematics and Blueprints Transportation Navigation Mapping Charts Signs Celestial Information Symbols Gestures Signs Control Speed Autopilot Traffic Scheduling Reservation Routing	Societal Human Needs Information Education Entertainment Leisure Employment Human Demands More Channels More TVs Instant information Morals and Values Personal Advertising Video Games Time Management Cultural Global Universal Technology Levels Transfer Assessment Appropriate Innovation Past Present Future Environmental Pollution Air Noise Static Land Antennae Telephone Poles Water Cables Space Satellites Underground Cables Resources Recycling Paper Silver Conservation Depletable Silver Trees

Figure 7c

Level 3 10-12 Grades

A. The main content emphasis for Level 3 is based on the need for the students to develop means and strategies to expand their skills and knowledge on the overall picture of technology and how man works in a technological society. Studies for this level could encompass the following:

- Set up and operate a model enterprise
- Community service activities by a group of students
- Self directed studies on a particular aspect of technology
- Aid in the instruction of technology for Levels 1 or 2



- Integrating activities with math, science, social studies, and English

B. Regardless of the activity the student or group of students select at this level, it is important that they be able to identify the various inputs, processes, and outputs for their particular activity. Also they should be able to identify the specific aspects of their organization activity as it relates to the four areas of Resources, Technical Processes, Industrial Application, and Technological Impact (Figs. 7a, b and c) that affect all of society.

C. This identification with the systems approach to the understanding of technology will allow the student to establish a framework upon which he/she will be able to evaluate the various careers available to them as they continue their senior high education.

D. The self directed studies area of the curriculum will give the student the opportunity to research a topic and become knowledgeable about a particular aspect of technology that may be well beyond the expertise of the industrial arts teacher or other faculty members. This is fully acceptable in that industrial arts teachers cannot hope to be experts on all phases of a rapidly expanding technological society.

Level 4 Advanced Technical and Vocational Education Studies

A. Content for the advanced technical studies is derived from many sources. Of primary importance is to keep the program emphasis and objectives in mind. Students should be provided with opportunities to use technical knowledge and skills to solve problems related to industry and technology. Studies are generally: individualized, research and development oriented, and laboratory based. Therefore, content at this level is going to be largely determined by the needs and desires of the student, teacher, and/or community.

B. Let's look at it this way. Science is the base upon which technology is founded. Technology courses focus on the application of scientific concepts. At the awareness level the student is applying elementary science concepts to develop an awareness of technology and industry. Junior high and 9th-10th grade students build upon awareness as they explore and become oriented to new applications in communication, production, and transportation. Advanced technical studies students, then, are attempting to become technically prepared. Content for this level will depend on the areas in which technical preparation is needed. Content is based upon:

1. What the student has developed an interest in and wishes to pursue in more depth.
2. What the teacher feels is an area that needs to be addressed due to new technologies.
3. Deficiencies or weaknesses that have not been addressed sufficiently throughout previous educational experiences which may be critical as one prepares for a career or to develop advanced technical knowledge.

4. Content that would serve as a basis for moving into a "high technology" curriculum at a later date. This might include a high technology core of competencies in science, physics, process control, computers, etc.

C. These guidelines for content selection may lead to an advanced technical studies program that redirects some student to other areas for indepth study in math, science, physics, chemistry, business, or others, depending on the identified needs. The teacher might also determine that advanced research and development in specific areas (like the units studied in orientation courses) is necessary. In that case, an entire course might be developed around topics such as geothermal energy, aviation technology, lasers, or robotics. A student could choose to become involved in an individual project focused on his/her interests. This may lead to student studies in holography, computer aided manufacturing systems (CAM), space shuttle design, or energy conservation. The possibilities are limitless.

D. Content selection should seem fairly clear by this time. But, deciding what to teach is not the only question that needs to be addressed when identifying "what needs to be done" for an advanced technical studies program. Other points will be discussed with all the levels together at the end of this guide.

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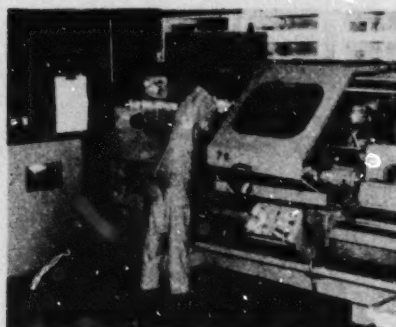
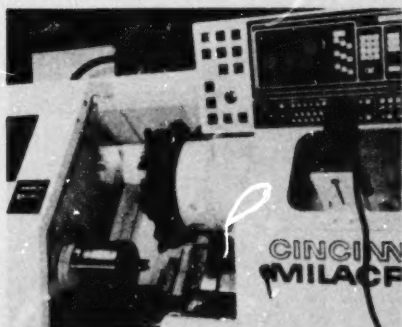


Level 5 Vocational Programs

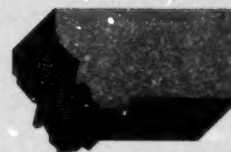
20

- A.** Curriculum content in vocational programs should be largely determined by employment need. Since vocational education programs are often evaluated according to the number of graduates who find employment in the field in which they are trained, it would seem important to plan a program that prepared people for the current job market. To determine demand, you can do two things: Take a local employment survey and/or contact the Montana Job Service.
- B.** The Montana Job Service conducts employment surveys periodically. By consulting your local telephone directory you can find the location nearest you. They may prove indispensable as a source for employment trends and information for planning an updated vocational program.
- C.** When conducting a local employment survey, consider following these steps:

 1. Organize and/or utilize an advisory committee
 2. Generate a list of potential employers
 3. Design a survey method/instrument
 4. Administer the survey
 5. Summarize the results
 6. Make decisions regarding further planning.
- D.** The importance of forming an advisory committee cannot be overemphasized. The committee, made up of interested, able and concerned citizens, is a vital link between the community and the school. They can provide the following types of advice and service: Community and student needs, Community support for the school and curricula, Recognition for student accomplishments, informational sources for educational experiences, Aid in evaluating the vocational program.
- E.** Another source for keeping your curriculum updated is to conduct follow-up studies of your graduates and employers of your graduates. They are in a good position to suggest changes that can lead to improvement.
- F.** Once you have identified employment trends and needs, it is necessary to start establishing your vocational program. For a vocational program to qualify for reimbursement it must include a set of sequential courses so that once a student begins a program, there are offerings available on a continuous basis.
- G.** The major objective of this level of the plan is to prepare students with the necessary knowledge and skills to become gainfully employed or advance in an industrial related occupation. With that objective in mind, and with the help of employment research, follow-up studies, and surveys, determining vocational curriculum content should be an easy task. Now that content selection guidelines have been established you'll need to write objectives and develop teaching strategies. Take a look now at other things that need to be done to update curriculum. All the levels are discussed together from this point.



Levels 1-5



13. As you attempt to identify what needs to be done to plan and implement technology education, you need to address these questions.

- What do I need to do to prepare for teaching the new content?
- What kind of changes need to be made to my laboratory/ classroom?
- What kinds of new equipment and materials do I need?

Let's look at these items one at a time.

14. What do you do to prepare to teach the new content? There are all kinds of ways to become prepared. Of course, you've already made the first step—developing a rationale for what you teach. Other alternate choices include: reading books and technical literature, looking at recent periodicals, writing to organizations and companies, contacting other teachers or the Industrial Education Specialist at OPI in Helena, seeking assistance from colleagues, attending workshops, enrolling in courses, visiting business/industry, contacting universities and working in business/industry. Help on how to find out about these resources is addressed in step number five.

15. What kinds of changes need to be made to my classroom? The best way to answer this question is to take a look at the course (or unit) you are developing. Then, answer these questions:

- Will students have space to work on the types of learning activities you have identified?
- Is there room for displays and models to be exhibited?
- Does the class or lab organization encourage interaction?
- Will the proposed curriculum affect class scheduling to the point where a major renovation will be necessary?

- Are there facilities to begin an area library?
- Is the class arrangement conducive for educational media usage?
- At the preparation level—Does the equipment give the students an opportunity to learn the skills they will use in industry?

Alternative answers to these questions will also be provided when we address the questions, "How do I go about it?" in step five. Let's look at our last question for "what needs to be done" now.

16. What kinds of new equipment and materials do I need? The answer to this inquiry is based on:

- The kind of teaching strategies and learning activities to be utilized
- The space and storage allotment you have to work with
- The amount of money you have to work with
- The facilities and equipment already intact.

17. How you go about implementing technology is an important step in the planning process. You've taken a look at four factors:

- What should you teach
- What you need to do to prepare to teach
- What kind of changes you need to make in the classroom
- What kinds of new equipment and materials you need

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How

Now . . . in step number five, we will look at:

- How you should teach
- How you can prepare to teach
- How you can make changes in the classroom
- How you decide what equipment and materials are needed

18. How should you teach? Take a look at all your options. . . then choose strategies that can effectively accomplish your goals and objectives. Be flexible, try many different instructional strategies throughout your lessons. Variety contributes to effectiveness! All of these strategies are familiar to you so further explanation is unnecessary. However, one needs to be emphasized. All superior Industrial Education Programs have an active youth organization. Two organizations are available. The American Industrial Arts Student Association (AIASA) is geared to primarily include students at the exploration and orientation levels while the Vocational Industrial Clubs of America (VICA) organization relates to students at the preparation level. Activities suggested by these organizations can, and should be integrated into classroom activities. In this way students can become involved in learning in a meaningful way. To find out who to contact for assistance in

beginning a youth organization, call the Industrial Education Specialist at OPI in Helena at 444-4452.

- 19.** How do you prepare to teach content? Earlier, we listed eight ways of preparing yourself. Let's look at those again.
- Reading books and technical literature. See the resource listing (pp. 26-27) for some suggestions. You may need to visit your local library or that of the nearest university. Try writing publishers for complimentary copies of textbooks.
 - Looking at recent periodicals. The bibliography listing again will help you find titles of good periodical resources. School and community libraries will probably carry these, or write the publishers.
 - Writing to organizations and companies. See the names and addresses in the bibliography listing and try to locate others of specific interest to you. Your local library carries phone books of major cities.
 - Contacting other teachers or the Industrial Education Curriculum Specialist at the Office of Public Instruction in Helena.
 - Seeking assistance from colleagues. Other teachers in your school may be able to provide valuable assistance.

Talk to other faculty members in your department and in other areas. The math, science, social studies, and business teachers should be contacted to discuss your curriculum content or activities and to possibly plan combined projects or learning experiences. There may be many opportunities for students to enhance their learning by becoming involved in activities that compliment each other in different classes.

- Attending workshops. Workshops will be held throughout the state to provide teachers with inservice training to plan technology courses. These workshops are an excellent opportunity for teachers to become familiar with technology education and to obtain help as forward looking industrial education programs are developed.
- Enrolling in courses. Courses are being developed at many universities throughout the country to provide interested persons with an opportunity to learn more about developing curriculum for specific technology courses. You may be able to receive graduate credit while you plan your updated program.
- Visiting business/industry. Take time to participate in tours of business and

industries in your area. Consider taking a trip to a city near you to get a first-hand view of the processes and operations being utilized.

- Contacting universities. University faculty can provide assistance, suggestions, names of consultants, materials, and other help. In addition, inservice activities can be provided to your school system.

20. The next question on our list of "How do I go about doing it" is: How do you make changes in the classroom? Good question. Look at these hints.

- Analyze your classroom space. If you think that there needs to be working space, try to sketch out a floor plan that would work. You will need to meet with other teachers who utilize the facilities to determine if the new arrangement will meet their needs too.
- Talk to the principal and other administrators about utilizing other school display cases and hallway bulletin boards for your classes.
- Take a good, hard look at your classroom. Is it doing the best job it can? There may be a better way to organize seats and tables, especially for discussion or seminar type activities.
- Whenever making changes, be sure to talk to all the parties involved

(administrators, other teachers, janitors, etc.).

- Consider class and lab arrangements that would make everything work better. Perhaps there is a way that you can organize it so certain orientation courses, for example, can utilize the same laboratory. Look into the possibility of utilizing other available classrooms for certain projects and needs.
- If a major renovation is necessary, be sure to cooperate with all others to find the best solution possible.

21. The last question of this section is: How do you decide what equipment and materials are needed? The best way to answer this is to follow these guidelines:

- Take your courses or unit outline(s) and make a list of the tools, equipment, and materials needed to complete it.
- Compare what is needed to what you have available to you at present, either in your immediate classroom/laboratory or in the school.
- Obtain your current budget allowance and determine how much you will be able to purchase.
- Base your priorities on the following: Which purchase will help the students to become more technologically literate? Which purchase will provide the greatest opportunities to explore a wide range of industrial situations as well as some of the technologies used in industry? Which purchase will meet the needs of the most students?
- Once you have analyzed the list of equipment and materials you feel are needed, take a look at other possibilities that may not have occurred to you before. Perhaps, one of the

following might be useful additions to your program.

- A computer
- Software
- Kits for researching and developing solar energy, aviation technology lasers, etc.
- A robot
- Video recorder/playback system for your classroom
- Models of innovative developments in communication, production, and transportation
- A laser

22. You should always remember that the absence of equipment and materials in your classroom should not necessarily mean the absence of that content from your program. If you do not have facilities and resources at your fingertips consider other sources and types of activities. Think about . . .

- Inviting guest speakers from industries, organizations, universities, and within the school.
- Borrowing some tools, materials, or educational aids from libraries, universities, other teachers within the school, industries, organizations, etc.
- Using recent media for current research and content for classroom activities including newspapers, magazines, books, slides, and films.
- Substituting easy to obtain materials for the costly materials often recommended for activities (cardboard instead of wood, styrofoam instead of balsa, etc.).

When

23. We have now reached the sixth step of the planning process, "When should you begin?" Again, you have many options.

- Start now, plan and implement simultaneously
- Plan now, start next semester
- Plan this year, start next year
- Gradually implement beginning now

24. As you decide when to begin implementation, consider how much and what needs to be done. If you feel that you will need technical preparation, you may decide that you need a semester or a year to plan the course. However, it may be sensible to implement gradually. You can implement slowly to become familiar with the new content. Most teachers have found that teaching about technology can be easily implemented right away, but you will need to meet with other faculty members in your department and the administrator in your school district.

25. The entire process will take approximately one year to implement because:

- Course titles and descriptions may need to be changed
- Course outlines and objectives will need to be approved by administrators
- Counselors will need to be educated about program changes
- Teachers need time to plan, teach, and evaluate programs for successful implementation.

26. Your next task is to plunge right in and *do it!* If you have followed all the steps to this point, you should be ready to give it your best shot. The first time is

always the hardest, so, don't become discouraged. Some teachers have explained that they almost feel like a first-year teacher, but the rewards are worth it.

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27. And, after you have tried it once, sit back and sigh . . . then, evaluate how it went.

- Did you meet the goals and objectives?
- Was the content up-to-date?
- Did you get the students involved?

28. As you evaluate your curriculum efforts, consider having students fill out questionnaires. Utilize the expertise of your colleagues to evaluate your efforts and build upon everything you learn. Follow the planning model and ask yourself . . .

- Why are you doing this? (Keep your program emphasis in mind)
- Where do you want the curriculum to go? (Are you getting there?)
- Who are you aiming the curriculum effort towards? (Did your students benefit?)
- What needs to be done? (Take a look at your content, classroom, and facilities)
- How do you go about doing it? (Are you trying alternative teaching strategies, looking at suggested resources, talking to others involved and evaluating your facilities?)

When should you start? Today!

Helpful Resources

Books

Bame, E. A. and Cummings, P. *Exploring Technology*. Davis Publications: Worchester, 1980.

This text provides a good background of all the technology systems including chapters on Energy and Power, Manufacturing, Construction, and Automation. Could be suitable for junior high and 9th-10th grade curriculum.

An excellent resource for teachers and students which is accompanied by a teacher's guide and activity manual.

Burke, J. *Connections*. Little, Brown and Co.: Boston, 1978.

Connections is a well-written and organized summary of technological developments and the interrelationship of inventions. It is highly recommended as a source for teachers and students as they become aware of the pace of technology and the impact it has on social growth and development. A series of movies and/or videotapes have been prepared which may be suitable for advanced high school programs or as resources for the teacher's technical growth.

Cornish, E. S. (Ed.) *The future: A guide to information sources*. World Future Society: Washington, D.C., 1979.

A great source for locating books, publications, names and addresses, organizations, and audio-visual aids that can help an educator learn and teach about technology and the future.

Darrow, D. and Pine, D. (Eds.) *Iowa Industrial Arts Handbook for Introductory Level-Production*. Department of Industrial Technology, University of Northern Iowa, Cedar Falls, 1980.

An excellent resource guide for teaching production and includes specific unit and lesson plans as well as a teachers guide with suggested class activities, tests, and additional resources. Covers both areas of manufacturing and construction.

DeVito, A. and Krockover, G. H. *Activities handbook for energy education*. Goodyear Publishing Co.: Santa Monica, 1981.

A well compiled book of energy activities for Kindergarten to the 12th grades. A resource listing at the end provides you with names and addresses of over one hundred places to contact for free and inexpensive materials.

DuVall, J. B., Maughan, G. R. Jr., and Berger, E. G. *Getting the message: The technology of communication*. Davis Publications: Worchester, 1981.

This book addresses all aspects of the communication system geared toward the higher

levels of high school or introductory college classes. It is a very good resource for teachers as they develop concepts about communication technology.

Fales, J., Sheets, E., Mervich, G., and Dinan, J. *Manufacturing: A basic text for industrial arts*. McKnight Publishing Co.: Bloomington, IL, 1980.

This is one of the best books on the market for teaching about manufacturing. It not only provides information on the steps of manufacturing, but also, contains plans for about 40 projects. A student workbook, instructor's guide and sound filmstrips are also available to accompany the text.

Garrison, A. J. *Solar projects*. Running Press: Philadelphia, 1981.

This book provides you with stencils and directions for creating all kinds of solar projects from simple sundials to solar collectors and a solar oven.

Heiner, C. W. and Hendrix, W. R. *People create technology*. Davis Publications: Worchester, 1980.

An excellent text that can be used at the junior high level or lower senior high level to develop concepts of technology and systems. An accompanying teacher's guide and activity manual make this text quite useful.

Laybourne, K. *Doing the media: A portfolio of activities, ideas and resources*. Dantree Press, 1978.

This book provides the teacher with a multitude of teaching strategies and learning activities that can be used from kindergarten through tenth grade to teach different aspects of communication. A great resource book.

Maley, D. A. *The industrial arts teacher's handbook*. Allyn and Bacon: Boston, 1978.

Maley makes an outstanding contribution to the quality of industrial education by providing educators with an evaluation of popular industrial arts plans, teaching methods, and instructional organization. It helps the teacher to identify alternative strategies and make good decisions about classroom educational practices.

Scobey, M. *Teaching children about technology*. McKnight Publishing Co.: Bloomington, 1968.

A well researched book which provides excellent background on teaching industrial arts to children. Scobey relates industrial arts to other curriculum areas and provides the reader with a sound framework for teaching at the elementary level. She addresses such areas as cybernation, construction, power, transportation and communications. Project and activity ideas are included.

Storkweather, Kendall N. (Ed.) *Technology Education: A Perspective on Implementation*. American Industrial Arts Association, Reston, VA, 1985.

Provides a broad perspective on technology education and develops a foundation upon which to build a quality program in a highly sophisticated technological society.

Taylor, P. *The kid's whole future catalog*. Random House: New York, 1982.

This is an excellent book full of facts, photos, experiments, and addresses to help you and your students learn about technologies of today and tomorrow. It includes chapters on Future Technology, Future Communication, Future Energy, Future Transportation, Future Work, and many more! Easy to read and understand.

Wright, R. T. and Jensen, T. R. *Manufacturing: Material processing, management, careers*. Goodheart-Willcox Co.: South Holland, IL, 1976.

A very good manufacturing text which covers the stages of production and the process of students putting together a manufacturing enterprise. An instructor's guide and lab manual accompanies the text.

Wright, R. T. and Sterry, L. *Industry and Technology Education*. The Technical Foundation of America, Lansing, IL, 1984.

A curriculum planning guide to help the contemporary industrial arts/technology teacher plan and develop forward looking programs for grades 6 through 12 in small, medium and large schools.

Organizations

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

The DOE publishes many brochures and curriculum aids that can serve as excellent resources for students and teachers. They also have a free loan policy on film and related audio-visual aids.

Curriculum Publications Clearinghouse
Western Illinois University
Macomb, IL 61455

The clearinghouse distributes many educational guides and materials on a cost recovery basis. Curriculum materials prepared for the Illinois Plan can be purchased through this organization. Contact them for a bibliography listing.

Periodicals

The following magazines and journals would be useful publications for technical content and background for industrial education courses. Consider examining these publications at the local library and recommend to your school librarian to subscribe to the ones you find most useful.

Communication Forum, C/O School of Technology, Eastern Illinois University, Charleston, IL 61920. Published in Fall and Spring, \$4.00/yr.

Datamation, Subscription Department, 875 Third Ave., New York, NY 10022. 12 issues/\$4.00.

Discover, Time-Life Building, 541 N. Fairbanks Court, Chicago, IL 60611. 12 issues/\$19.95.

The Futurist, C/O World Future Society Headquarters, 4916 St. Elmo Ave., Bethesda, MD 20814-5089.

High Technology, P.O. Box 2808, Boulder, CO 80321. 12 issues for \$21.00.

Industrial Research and Development, Circulation Dept., Box 1172, Radio City Station, NY 10101. 12 issues/\$36.00.

Manufacturing Forum, Department of Industrial Education and Technology, Ball State University, Muncie, IN 47306. Published 3 times per year \$3.00/yr.

Omni, 80 New Bridge Road, Bergenfield, NJ 07621. 12 issues/\$24.00/yr.

Popular Science, Subscription Dept., Boulder, CO 80302. 12 issues/ \$13.94.

Science, Subscription Dept., P.O. Box 10790, Des Moines, IA 50340. 10 issues/\$15.00.

Science Digest, P.O. Box 10076, Des Moines, IA 50350. 12 issues/\$13.97.

Technology Illustrated, P.O. Box 2804, Boulder, CO 80321. 12 issues/\$18/yr.

The Technology Teacher (Official Journal of the American Industrial Arts Association), American Industrial Arts Association, 1914 Association Drive, Reston, VA 22091. Eight issues/\$20/yr.

Acknowledgments

This planning guide has been developed through a grant from the Office of Public Instruction, Helena, Montana, in coordination with the state specialist for Industrial Education, Mr. Jeff Wulf and under the direction of Dr. Doug Polette and his graduate assistant, Mr. Brian Crandell, department of Agricultural & Industrial Education, Montana State University, Bozeman, Montana.

Special acknowledgments are due to the Illinois State Board of Education and the department of Adult Vocational and Technical Education and the project director, Dr. Franz Loepp who, with his project staff, developed the *Illinois Plan for Industrial Education—A Planning Guide*, of which large portions were used for Montana's Industrial Education guide. Appreciation is also extended to the Technical Foundation of America under

whose grant project directors, Thomas Wright and Len Sterry, developed *Industry & Technology Education—A Guide for Curriculum Designers Implementors and Teachers*.

Also special thanks are due to editors, James A. Hales and James F. Snyder, for their publication *Jackson's Mill industrial Arts Curriculum Theory* which provided considerable input for Montana's effort to develop forward looking curriculum materials.

Additional individuals whose efforts contributed greatly to the development of this guide were the following Montana industrial education instructors who participated in the six regional industrial education workshops and the summer update conference, or served on the curriculum steering committee.

Bill Molnik, *Pine Hills School—Miles City*
 Rene Lane, *Pine Hills*
 Dale Abbott, *Pine Hills*
 Armin Pilling, *Pine Hills*
 Dave Roos, *Scobey*
 Steven Ray, *Broadus*
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 Paul Armstrong, *Miles City CCDHS*
 Carroll Severnson, *Miles City CCDHS*
 Lyle Swenson, *Terry*
 Bob Stoltz, *Glendive DCHS*
 Pat McLinden, *Richey*
 Don Bray, *Jordan*
 Allyn Larsen, *Wibaux*
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 Ken Lutz, *Hamilton*
 John Mikesell, *Hamilton*
 Bill Molenda, *Darby*
 Robert Banderob, *Darby*
 Dean Martin, *Missoula Sentinel*
 Lou Taberna, *Missoula Sentinel*
 John Digalis, *Anaconda High*
 Robert Gutcheck, *Anaconda High*
 Paul Maes, *Anaconda High*
 Jerry Brule, *Arlee High*
 Chuck Melaney, *Victor High*
 Mark Bryn, *Big Sky High School—Missoula*
 Glenn Paulson, *Arlee High School*
 San Citron, *Whitefish High School*
 Morris Brenden, *Kalispell Junior High*
 Bob Halvorsen, *Libby Senior High*
 Kenneth Wilson, *Whitefish High School*

Fred Caster, *Whitefish High School*
 Tony Hecimovich, *Whitefish High School*
 Maurice Anderson, *Libby Junior High*
 Dick Kenck, *Libby High School*
 Bill Taylor, *Polson High School*
 Art Baumann, *Kalispell*
 Lloyd Wilson, *Kalispell*
 Bruce Chandler, *Kalispell*
 Dennis Swensgard, *Kalispell*
 Bob Lawson, *Whitefish*
 Dave Seeley, *Kremlin—Gildford*
 Jack Linquist, *Kremlin—Gildford*
 Dean Wester, *C. M. Russell*
 Pat Trujillo, *C. M. Russell*
 Martin Dickerson, *Box Elder*
 Scott Davis, *Highwood*
 Kent R. Squires, *Fort Benton*
 Roger Viallette, *Northern Montana College*
 Ray Erbe, *Fort Benton*
 Steve Diedrich, *Fairfield*
 Dan Corcoran, *Cut Bank*
 Bill Olfert, *Cut Bank*
 Cal Warrington, *Havre High School*
 Earl Furlong, *Geraldine High School*
 Lowell Hogenson, *C. M. Russell*
 Keith Lomica, *Great Falls High*
 Doug Cianin, *North Junior High*
 Jim Carroll, *Moore High School*
 Ray D. Stubbs, *Bozeman Senior High*
 Dale Maroney, *Bozeman Senior High*
 John Yeager, *Jefferson High—Boulder*
 Wes Wagenaar, *Sweet Grass Co. H.S.—Big Timber*
 Dan Scott, *Western—Dillon*
 Jay McCurry, *Three Forks High School*

Clay Anders, *Western Mt. College—Dillon*
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 Stephen Willner, *MSU*
 Dave Pyle, *MSU*
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 Max L. Amberson, *MSU*
 Glen Rintamaki, *Bozeman High School*
 Pat Behm, *Bozeman*
 Bruce Howard, *local building contractor*
 Richard Hagen, *Livingston*
 Jeff Salisbury, *Wilsall*
 Dennis Bodily, *Bozeman Senior High*
 Bill Dotter, *Helena Junior High*
 Larry Mires, *Glasgow*
 Fred Picco, *Lewistown*
 Don Peace, *Lewistown*
 Roy Ehresmann, *Livingston*
 Howard Convergood, *Rudyard*
 Lyle Egman, *East Helena*
 Dave Watkins, *Northern Montana College*
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 Ed Dawes, *Capital High School, Helena*
 Randy Boumans, *Valier*